21 March 1962

MEMORANDUM FOR: Chief, Technical Plans & Development Staff

THROUGH: Acting Chief, Technical Development Branch

SUBJECT: NPIC Proposal [redacted] Change Detector Studies STATINTL

1. Further to my memos of 4 January and 1 March 1962, I have discussed the proposal again with [redacted] GIMRADA. STATINTL

2. [redacted] has now accumulated fairly strong evidence from several sources, which indicates that the Change Detector will be of great value to interpretation units other than ourselves. This evidence together with a supporting paper by [redacted] will be in our hands very shortly, and when available I will complete the proposal evaluation. I feel sure that I will recommend a "go ahead", the cost being approximately [redacted] STATINTL STATINTL STATINTL

3. Whilst the Change Detector as such will not primarily be a tool for our use, one aspect of the equipment is of great interest to us, namely the correlation technique employed. The [redacted] correlator will be checked out very soon by us, and I propose to request a trip [redacted] at the same time to study their development of the 9 shot camera. The geometric aspect of this camera is extremely important in considering it for possible correlation technique collection. Based on the check out of the [redacted] correlator and the possibilities inherent in the [redacted] camera, I will then be in a position to evaluate a further decision regarding follow-on procurement of fully automatic correlation equipment. We currently have a proposal by [redacted] concerning such equipment, but I am sure that the [redacted] technique which will be developed as a result of building a change detector, will also be very much applicable to automatic correlation. We shall, therefore, be killing two birds with one stone by supporting the [redacted] Change Detector, as out of it we shall also get the basis of a fully automatic Servo-controlled correlator. STATINTL STATINTL STATINTL STATINTL STATINTL STATINTL STATINTL STATINTL STATINTL

4. Should we, therefore, follow on with fully automatic correlation I think we should consider [redacted] as all being capable of doing the job and evaluate proposals from all three before making further decisions.

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20 March 1962

USE OF A CHANGE DETECTOR IN INTELLIGENCE OPERATIONS

1. During the years since World War II military research and development has produced both combat missiles with tactical atomic warheads and intercontinental ballistic missiles capable of placing larger atomic and thermonuclear warheads on targets. The impact of these developments on modern warfare has been severe. From an intelligence standpoint, one of the most important changes is that of time compression. Warning time may vary from none at all on the battlefield to a few minutes at best, and to approximately fifteen minutes in the case of intercontinental missile warfare. This has had a most pronounced effect on trends in concepts of intelligence and intelligence systems development. Never before has there been such a premium on targeting intelligence and the identification of those patterns of action that signify an intention to commence general warfare operations. In the case of strategic intelligence, this information now must be available in some useful degree of detail before the advent of hostilities. In combat intelligence "flash" photo interpretation to identify and locate enemy weapons systems capable of delivering nuclear attack is of the highest priority. Thus, there is today an apparent reversal of the "classical" intelligence situation, with national survival largely depending on intelligence information acquired well before the outbreak of hostilities.

2. A general examination of concepts of use, technological trends, and the state-of-the-art in reconnaissance systems reveals a greatly increased capability to collect information quickly over vast areas of the earth, including the whole of the earth's surface if desired, by systems ranging from manned high performance systems to satellite systems. In combat intelligence the Army concept of battlefield surveillance through a variety of means indicates that the volume of imagery made available to the intelligence analyst will surpass all previous cases. Current military intelligence concepts and technical means available for their execution indicate a considerable volume of repetitive area coverage, larger volumes of imagery, and considerably reduced time for its analysis. Within the intelligence community great emphasis has been placed on collection of information; however, a far less amount of effort has been devoted to production of finished intelligence. From a technical standpoint, the state-of-the-art in intelligence collection is far ahead of that in intelligence production.

3. Within this context it is felt that a device called a Change Detector would be a most useful tool. Essentially, all intelligence consists of the detection of changes to the currently known situation and analysis of the significance of the changes. A Change Detector is a flexible device that may be operated manually or automatically and that will

present, in a few seconds, all changes reflected on the film of two images of the same area. It can process imagery [redacted] STATINTL It cannot, nor is it intended to, identify the changes STATINTL and this must be done by the intelligence analyst. Imagery coordinates of changes of great interest may be obtained by the operator and presented on the console or may be read out on punched cards, paper tape, or magnetic tape if desired. These could be automatically converted to a desired grid system.

4. Basically, the Change Detector is designed to assist in the timely processing of intelligence data for command decision. It does this by providing an automatic (or manual, if desired) capability to the intelligence interpreter for processing a fixed amount of imagery in a shorter period of time or processing a much larger quantity of imagery faster than now possible by reducing the search time required to identify all changes. Additional examples of the capabilities and usefulness of a Change Detector are indicated in the following sub-paragraphs. They are by no means a complete itemization, but should serve to convey to the reader some indication of its intelligence potential.

a. Detection of changes. The Change Detector will detect all natural and man-made changes contained on film of "before" and "after" shots of the same area. A capability for screening out shadows and clouds by means of electronic clipping techniques will be incorporated for both automatic and manual operation at the option of the operator since some natural changes may be induced by human activity.

b. Pattern of changes. A Change Detector will immediately present the pattern of all changes contained in the film. In many cases the pattern of military changes viewed over large areas is the key to their understanding. The Change Detector is an intelligence research tool that may be used to eclipse time and visually examine and study in a matter of minutes changes that are the results of months to years of activity. It should make it possible to study the significance of the pattern of changes and increase the value of this technique for intelligence.

c. Time and accuracy of correlation and registration. The Change Detector capability for quickly, accurately and repeatably correlating and achieving registration of two scenes exceeds that of any manual operation or operator. It can obtain registration in a matter of approximately three seconds. A trained semi-skilled operator suffices for its operation, thus freeing the highly trained photo interpreter for those tasks where he can make his greatest contribution.

d. Probability of significant intelligence data. The Change Detector by the rapid display of all changes present in the two films immediately directs the interpreter to those areas that have the highest probability of significant intelligence data.

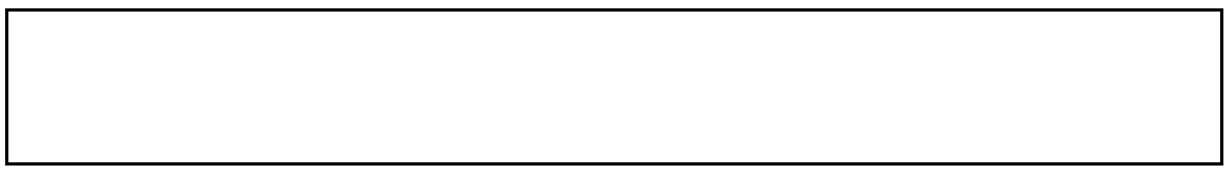
e. Quantitative measure of activity. The Change Detector is a tool that can be used to provide a quantitative measure of activity, since military activities can be defined as a function of the number, type, and extent of changes identified in a given area with a given time.

f. Aid to intelligence planning. The identification of areas with a high level of significant changes serves as an aid in intelligence planning by identification of well defined areas for subsequent reconnaissance collection activities.

g. Development of new and significant correlations. The Change Detecgor, by helping the intelligence analyst to examine changes on a national basis (assuming such large area coverage) will enable the discovery of new and militarily significant correlations of data that can come only from the ability to examine such coverage easily, quickly, and visually.

h. Maps and chart updating. Many of our current maps and charts are based on photo coverage obtained many years ago. Natural and man-made changes have since lowered their adequacy as far as currency of information is concerned. A Change Detector can be a most helpful device in the compilation stages of map production by enabling the interpreter quickly to see all the changes rather than have to search them out change by change.

i. Processing of large volumes of imagery. It has been estimated (1) that film loads of approximately 100,000 pictures a day will be taken in the field Army area. Estimates of current photo interpretation rates tend to indicate that approximately 12,000 man years of work would be required to process this quantity of film in one year of combat. This is far beyond our present photo interpretation capability. If the field Army area of interest is considered to be 100x300 nautical miles and it is photographed with a 12 inch focal length camera from an altitude of 2,000 feet, using a 9 inch film format, then approximately 480,000 frames of photography will be produced in a single day's coverage. Needless to say, there is no present day capability to extract intelligence from such a volume of photography in any reasonable time. The solution lies in the development of aids and screening devices to assist the photo interpreter. The Change Detector is one such screening aid, and provides a device around which other screening aids may be added to further increase processing ability.



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j. Rapid quantitative damage assessment. "Before" and "after" reconnaissance photography correlated and registered on the Change Detector provides the photo interpreter a capability of rapidly ascertaining the exact extent and amount of damage sustained by a target since all damage would be presented as changes.

k. Mine detection. Preliminary experimentation with breadboard models of the Change Detector indicate that it will "recognize" mine field emplacements, both tactical and strategic, and present them as changes. The pattern of minefields was quite obvious, and it should be possible to plot their positions on a topographic map with considerable accuracy and to plan for their removal or neutralization.

l. Types of combat changes. The Change Detector will present all changes between two sets of photography of the same area contained in the film. Some of the items that will be presented on changes are: fortifications of all types, munitions dumps, camps, vehicles, convoys, missile sites, weapons (tanks, tube artillery, etc.) wire emplacements, barriers, and indications of Enemy Order of Battle. Considered more abstractly, the Change Detector, although it cannot identify changes, can show whether the change is an addition to the scene, a subtraction from the scene, or a change of position within the scene.

m. Strategic intelligence considerations. Satellites offer a technical means to photograph the land surface of the world. Development of change detectors can, within a few years, provide an automatic means for screening such photography and identifying all changes since the last such photography in a period of 24-48 hours, thus providing a rapid intelligence capability to be aware of high priority data on a continuing world wide basis.